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JAGTIANI + GUTTAG
10363-A DEMOCRACY LANE
FAIRFAX, VA 22030

EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/661,651
Filing Date: September 12, 2003
Appellant(s): DAVIS ET AL.

Eric W. Guttag
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 5/19/06 appealing from the Office action mailed 1/17/06.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

6,077,002	LOWE	6-2000
5,126,005	BLAKE	6-1992
4,534,823	FISHTER ET AL.	8-1985
5,259,920	LAW	11-1993

John R. Walker, "Machining Fundamentals" (2000) pp. 511-516.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim 1, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516.

Regarding Claim 1, the admitted prior art (APA) teaches a method of milling a gas turbine engine blisk (bladed disk) having a hub and a plurality of blades made of metal spaced circumferentially around the hub and extending radially outwardly therefrom, each of the blades of the blisk having a leading edge, a trailing edge, a chord defined by a line extending from the leading to the trailing edge, a convex curved surface, a concave curved surface and a thickness defined between the convex and the concave surfaces, the method comprising the step of treating at least one blade of the blisk with a mechanical machining process for the metal that the at least one blade is made of for a period of time sufficient to change the at least one of the chord and thickness. (*See Paragraphs 2-6 of the instant application*)

Alternatively, Lowe teaches a method of selective milling a gas turbine engine blisk having a hub and a plurality of blades made of metal spaced circumferentially around the hub and extending radially outwardly therefrom, each of the blades of the blisk having a leading edge, a trailing edge, a chord defined by a line extending from the leading to the trailing edge, a convex curved surface, a concave curved surface and a thickness defined between the convex and the concave surfaces, the method comprising the step of treating at least one blade of the blisk with a mechanical machining process for the metal that the at least one blade is made of for a period of time sufficient to change the at least one of the chord and thickness so that the blisk is balanced. (See Column 1, Line 1 – Column 2, Line 64). Lowe teaches that balance may be achieved by removing additional material from individual airfoils

Regarding Claim 9, the admitted prior art (APA) further teaches a method for balancing a gas turbine engine blisk that is rotationally imbalanced comprising the steps of evaluating the rotationally imbalanced blisk to determine the direction and magnitude of the rotational imbalance, identifying at least one blade of the rotationally imbalanced blisk for potential treatment to correct the rotational imbalance of the blisk, determining which blade should be treated to correct the rotational imbalance, and selectively treating the determined at least one blade of the blisk with a mechanical machining process for the metal that the at least one blade is made of for a period of time sufficient to change the at least one of the chord and thickness. (See Paragraphs 5-8)

Neither Lowe, nor the admitted prior art teach treating the blade with a chemical etchant.

However, Walker teaches that it is old in the machining art to use chemical etching to remove material from a contoured or shaped metal part. Walker further teaches that chemical etching is complementary to conventional milling processes to form parts having more exact dimensions (See Page 512). In view of Walker, it would have been obvious to one of ordinary skill in the art at the time of invention to modify the conventional milling process disclosed in Lowe and the APA to include chemical etching (milling), in order to provide exact dimensions for the blisk, thereby reducing blade-to-blade variations and improving the balance of the blisk.

Regarding Claim 10, the APA in view of Walker does not explicitly teach determining whether the blisk is rotationally balanced, and if it is not, repeating the chemical etching process. However, it would have been obvious to one of ordinary skill in the art at the time of invention to repeat the process in order to determine that the blisk is balanced. Note that the APA teaches that conventional balancing machines are used to determine balance of a rotating object such as a blisk. Therefore the use of such machines would have been entirely obvious to determine that the balancing process is successful within the desired tolerances. Of course, performing the balancing process is an obvious expedient for balancing the blisk if it is determined that the balancing process has not balanced the wheel to the desired tolerances.

Claims 2-4 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, and in further view of U.S. Patent 4,534,823 to Fishter et al.

Regarding claims 2-4,and 11-13, as applied above, Lowe or the APA in view of Walker teach the method of the invention substantially as claimed, but do not expressly teach the chemical etchant comprising at least one acid selected from hydrofluoric, nitric, hydrochloric, sulfuric, and mixtures thereof.

However, the use of etchant solutions containing, for example, nitric acid is old in the art of etching metals used in the production of turbine blades and the like. For example, Fishter et al. teach that solutions for etching gas turbine superalloys include solutions of hydrochloric and nitric acid. (See Col. 2, Lines 14-16)

In view of Fishter et al, it would have been obvious to one of ordinary skill in the art at the time of invention to use a chemical solution including the listed acids since the same were known at the time of invention to be suitable for etching superalloy gas turbine materials.

Claims 5-7 and 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, in view of U.S. Patent 4,534,823 to Fishter et al. and in further view of U.S. Patent 5,126,005 to Blake.

Regarding claims 5-7 and 14-17, as applied above, Lowe or the APA in view of Walker and Fishter et al. teach the method of the invention substantially as claimed, but do not expressly teach immersing at least two blades of the blisk in the solution, the at least two blades of the blisk including the at least one blade to be treated with the solution and at least one blade not to be treated with the solution, and which comprises the further step of applying to the surfaces that are potentially in contact with the solution of the at least one blade that is not to be treated with the solution a maskant that is chemically resistant to the solution, the maskant being applied to the surfaces prior to immersion of the at least two blades of the blisk in the solution.

However, the use of a plastic film or coating as a maskant to selectively etch a surface is notoriously old and well known in the chemical solution etching art. For example, Blake teaches that a plastic film may be applied prior to immersion in a chemical solution in order protect regions of a metal part in which chemical milling is not desired. (See Col. 2, Lines 7-50) Blake further teaches that it is known to remove the maskant and repeat the etching process (See Col. 1, Lines 30-44)

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the process of the APA or Lowe in view of Fishter et al. to use a plastic film or coating as a maskant as shown by Blake, and to immerse at least two blades in the solution and to selectively mask areas of the turbine blades because this will allow for etching selected portions of the blades without having to move the blisk, thus decreasing processing time. Further, It would have been obvious to remove the maskant and repeat the etching process in order to remove material from the desired portions of the blades, thereby balancing

the blisk through the etching process. Immersing solely the at least one blade to be treated reads on the immersion of the blades since any blades that are immersed are effectively treated.

Claims 8 and 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, in view of U.S. Patent 4,534,823 to Fishter et al. and in further view of U.S. Patent 5,259,920 to Law.

Regarding claims 8 and 18-20, as applied above, Lowe or the APA in view of Walker and Fishter et al. teach the method of the invention substantially as claimed, but do not expressly teach a reference panel made of the same metal as the at least one blade to monitor the etching rate.

However, Law teaches the use of a reference panel made of the same metal as the workpiece in order to determine etch rate for the process. (See Col. 1, Lines 5-38)

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the process of the APA or Lowe in view of Fishter et al. to use a reference panel made of the same material as the treated blade in order to accurately determine the etch rate and thus predict the change in dimensions of the workpiece improving the efficiency of the process. Further, since the etch rate of the reference panel inherently predicts the amount of material removed from the workpiece, and thus the balance of the blisk, it would have been obvious to one of ordinary skill in the art at the time of invention to use the reduction in thickness of the reference panel to predict whether the treated blisk is balanced.

Regarding Claim 19, titanium, steel, nickel, tungsten and alloy thereof are well known for construction of turbine blades and the like, as shown by Fishter et al for example, and would therefore be obvious to use as reference panel metals.

(10) Response to Argument

Appellant's arguments filed 5/19/06 have been fully considered but they are not persuasive.

A. Rejection of Claims 1, 9 and 10 under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516.

1. Appellant has argued that the APA and Lowe do not teach or suggest treating at least one blade of an imbalanced blisk with a chemical etchant to provide a balanced blisk. However, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

2. Appellant has argued that the APA does not teach or suggest steps (a) through (d) of Claim 9. In support, Appellant states that "*Nowhere does paragraphs [0005]-[0006] of the application use wording that is that is the same or similar to that of steps (a)-(d) in claim 9.*" The argument is not persuasive to overcome the rejection because the claimed steps are taught at paragraphs [0005-0008] not [0005]-[0006]. The fact that different *wording* is used to teach the balancing method is irrelevant. Regarding step (a), evaluating the imbalanced blisk to determine the direction and magnitude of the rotational imbalance is equivalent to "*measure the imbalance force vector having a magnitude*" as recited in paragraph 7 of the APA. Steps (b) and (c) recite identifying at least one blade of the rotationally imbalanced blisk for potential treatment to correct the rotational imbalance of the blisk and determining which of the at least one blade should be treated to correct the rotational imbalance of the blisk. The APA similarly teaches, "material can be removed from identified blades", as recited in paragraph 8. Step (d) is not entirely taught by the (APA) prior art but is based on combination with the teachings of Walker. Since appellant has only generally alleged that steps (a)-(d) are not taught by the APA, and it appears that all of the method steps are equivalently recited, appellant is respectfully requested to specifically point out any steps or limitations that are not equivalently recited.

3. Appellant has argued that the APA does not teach or suggest steps (e) or (f) of Claim 10. However, Claim 10 merely recites determining if the blisk is balanced and repeating the balancing process. Since it is the object of Lowe and the APA to balance a blisk to a desired tolerance, and the

APA teaches that conventional balancing machines are used to determine the amount of rotational imbalance of a blisk, it would have been obvious to one of ordinary skill in the art to determine the amount of rotational imbalance using the conventional machines, and to perform additional balancing if the desired balance is not achieved.

4. Appellant has argued that Walker does not teach or suggest chemical milling of the blades of a rotationally imbalanced blisk to achieve rotational balance of the blisk. In support, appellant argues that Walker teaches machining parts to "exacting tolerances", and that achieving exacting tolerances is not what is important in creating rotationally balanced blisks, since the blades could be exactly the same, but offset from the blisk centerline, thus making the blisk unbalanced. However, the argument is unpersuasive because Walker does not teach that tolerances for etched parts must be exactly the same relative to each other, only that chemical etching provides fine control (exacting tolerances) over mechanical milling. Further the APA and Lowe teach removing material from the blades of an unbalanced blisk to more exact or balanced dimensions, not necessarily towards blades having exact dimensions relative to each other. Lowe teaches forming more exact dimensions using "additional milling" to improve balance (Col. 2, Lines 49-64) The APA further teaches "*Another prior method is to mechanically polish or machine the blisk to remove metal from the blades, flanges and/or platform region between the blade roots to adjust the rotational balance of the blisk, e.g., by offset/eccentric grinding of the blisk. The disadvantages of mechanical machining methods include the risk of damaging the blades or other portions of the blisk, the difficulty in finely controlling the changes in the chord and/or thickness of the blades*".

5. Appellant has argued that there in no proper motivation to combine Walker with the APA or Lowe. The motivation to combine Lowe or the (APA) with Walker is that the APA and Lowe teach fine adjustment in the dimensions of a metal workpiece to balance a blisk and Walker provides a suitable method for fine adjustment of the dimensions of a metal workpeice. Further motivation to use chemical etching as a removal technique is provided in Walker, (p.516) such as lower tooling costs, no burrs formed, etc.

Appellant has further argued that Walker is not directed at correcting rotational imbalances in blisks since Walker teaches static non-rotating components. The argument is a piecemeal analysis of the references since the APA and Lowe teach removing material to correct blisk imbalances.

B. Rejection of Claims 2-4 and 11-13 under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, and in further view of U.S. Patent 4,534,823 to Fishter et al.

1. Appellant as argued that there is no proper motivation to combine Fishter et al. with Walker, the alleged APA and Lowe. However the selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) In this case Fishter merely teaches a conventional etchant for the metal material of Lowe and the APA.

2. Appellant has further argued that chemical milling according to Fishter et al. is for the purpose of not adversely affecting (at least metallurgically) the part being processed. However the argument is unpersuasive to overcome the rejection. The fact that etchant of Fishter et al. effectively etches and removes the metal material without intergrannular or selective localized attack producing pitting or an uneven surface only supports its use as an etchant for turbine blade alloys. See (C3, L8-19) of Fishter et al.

C. Rejection of Claims 5-7 and 14-17 under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, in view of U.S. Patent 4,534,823 to Fishter et al. and in further view of U.S. Patent 5,126,005 to Blake.

1. Appellant has argued that there is no proper motivation for the combination of Blake with the APA Lowe, Walker and Fishter et al. However, The APA and Lowe, teach selective material removal, Walker further teaches that masking is a conventional part of chemical milling (p. 512) Therefore, one skilled in the art would look to the teachings of Blake, which provide suitable masking techniques and materials for the selective chemical milling (etching) of a workpiece.

2. Appellant has argued that Blake does not teach balancing a component. However this is a piecemeal analysis of the rejection, since Blake is not relied upon to teach correcting the rotational imbalance of a blisk.

3. Appellant has argued that (C1, L30-44) of Blake are considered not to provide sufficient benefits and would not be used by Blake. The argument is not persuasive, since a prior art process remains a viable prior art process even after improvements have been made.

4. Appellant has argued that nowhere is it alleged that the prior art teaches or suggests immersing solely the at least one blade to be treated. However the step of immersing solely the at least one blade to be treated, reads broadly on the immersion of any number of blades since any blades that are immersed are effectively treated as broadly claimed by appellant.

D. Claims 8 and 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) or, alternatively U.S. Patent 6,077,002 to Lowe in view of John R. Walker, *Machining Fundamentals*, 2000 pp. 511-516, in view of U.S. Patent 4,534,823 to Fishter et al. and in further view of U.S. Patent 5,259,920 to Law.

1. Applicant has argued that there is no proper motivation to combine Law with the prior art references.

2. Appellant has argued that etching a pattern in a part is not the same or equivalent to changing the dimensions of a part. The argument is unpersuasive since etching a pattern in a part clearly changes the dimensions of that part.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Roberts Culbert

Conferees:

Parviz Hassanzadeh

Gregory Mills